BOOKS

An Index to the Two-Phase Gas-Liquid Flow Literature, S. William Gouse, Jr., M.I.T. Press, Massachusetts Institute of Technology, Cambridge, Massachusetts (1966). M.I.T. Report No. 9, 867 pages, $15.00.

Professor Gouse's compilations are often mentioned in citing and predicting the staggering output of publications on two-phase gas-liquid flow. For example, the current doubling time of the cumulative literature is about five years, and approximately one thousand new documents were expected in 1966! A single paper back edition of the "Index" is now available and it consists of a three-part bibliography: Part I, issued May, 1963, contains 2,000 sources; Part II, issued September, 1964, adds 1,800 more references; and Part III, issued January, 1966, with some 1965 year references, brings the total sources to 5,253. As is noted, "To one somewhat familiar with the problem areas involved, these indices should be relatively easy to use. To a novice, the total amount of literature may appear overwhelming." Savings in publication costs were effected by presenting the parts with separate tabulations, and errata for each part have also been listed.

Obviously with such masses of literature, no critical review was attempted, nor have any abstracts been included. The three separate bibliographies are ordered only in the manner in which the references were found and verified. The usefulness of the "Index" is enhanced by the separate listings of subject, author (only first name appearing in the reference), and sources. Major subject areas are boiling (22), bubbles (4), capillary tube (1), closed loops (12), compressible flow phenomena (5), flow oscillations (10), gas lift pump, two-phase flow (6), void fractions (3), and miscellaneous (18). The number in the parenthesis indicates the number of subdivisions listed. Condensation, cavitation, and atomization are major areas not included, except in a peripheral fashion. The author is to be commended for his diligence in seeking sources, verification of the references, and examination of most of the papers for a proper reflection of the subject contents.

One interesting innovation is the listing of the most frequently cited literature. The final compilation yielded eighty-five sources under the heading "Two-phase flow with heat transfer (boiling and/or evaporation), ninety-two under "Two phase flow—not pri-

(Continued on page 617)

(Continued from page 417)

INFORMATION RETRIEVAL *

Diffusion and dispersion in porous media, Whitaker, Stephen, **A.I.Ch.E. Journal, 13,** No. 3, p. 420 (May, 1967).

Key Words: A. Diffusion-8, Dispersion-8, Dispersion Equation-8, Porous Media-9, Anisotropic-0, Dispersion Vector-8, Tortuosity Vector-8, Flow-9, Laminar-0, Incompressible-0, Differential Equations-10.

Abstract: The dispersion equation for a single, nonreacting, nonadsorbing species is derived for incompressible, laminar flow in anisotropic porous media.

The relationship between transport properties and rates of freeze-drying of poultry meat, Sandall, Orville C., C. Judson King, and C. R. Wilke, **A.I.Ch.E. Journal, 13,** No. 3, p. 428 (May, 1967).

Key Words: A. Transport Properties-6, Heat Transfer-6, Mass Transfer-6, Thermal Conductivity-6, Pressure-6, Nitrogen-6, Helium-6, Inert Gas-6, Freeze-Drying-8, 7, Drying-8, 7, Poultry-9, Turkey-9.

Abstract: This paper presents the results of an experimental study of freeze-drying under controlled and analyzable conditions. The major aim was to develop and confirm a model which relates the fundamental transport properties of the dried material to the observed drying rates.

Flow work exchanger, Cheng, Chen-yen, Sing-wang Cheng, and Liang-tseng Fan, **A.I.Ch.E. Journal, 13,** No. 3, p. 438 (May, 1967).

Key Words: A. Flow Work Exchanger-8, Pressurizing-8, 4, Feedstocks-9, Depressurizing-8, 4, Products-9, Pumps-10, Turbines-10, Desalination-4, Reverse Osmosis-10, Freezing-10, Hydrogenation-4, Synthesis-4, Phenol-2, Chlorobenzene-1.

Abstract: A flow work exchanger which offers an efficient and economical scheme for simultaneously pressurizing a fluid stream and depressurizing a substantially equivalent volume of another fluid stream is described. Several high-pressure processes are used to illustrate the application of a flow work exchanger.

The mechanics of a spray column, Letan, Ruth, and Ephraim Kehat, **A.I.Ch.E. Journal, 13,** No. 3, p. 443 (May, 1967).

Key Words: A. Holdup-8, 7, Drop Size Distribution-8, 7, Drop Size-8, 7, Flow Rate-6, Kerosene-9, Water-9, Spray Column-8, 9, 10, Flooding-8, Heat Exchanger-8, 10, Position-6, Column-9, Packing-6.

Abstract: Local and average holdup and drop size distribution as a function of low rates were measured for kerosene drops and water in a countercurrent spray column. At the same pairs of low rates of the dispersed and the continuous phases in spray columns, three modes of drop packings can be obtained. These are termed dispersed, restrained, and dense packings. For dispersed packing at low flow rates of the two phases, the holdup and the drop size are constant along the column. At high flow rates the drop size increases from bottom to top of the column and the holdup increases from top to bottom of the column.

Influence of resin selectivity on film diffusion-controlled ion exchange, Copeland, J. P., C. L. Henderson, and J. M. Marchello, **A.I.Ch.E. Journal, 13,** No. 3, p. 449 (May, 1967).

Key Words: A. Ion Exchange-8, 7, Selectivity-6, Resin-9, Ion Exchange Resin-6, 9, Nernst-Planck Equations-10, Diffusivity-6.

Abstract: An analytic solution of the Nernst-Planck equations is derived which applies to a selective resin when film diffusion controls. The selectivity has a marked effect on the rate of exchange for a wide range of diffusivities.

Free tear sheets of the information retrieval entries in this issue may be obtained by writing to the New York office.

* For details on the use of these Key Words and the A.I.Ch.E. Information Retrieval Program, see **Chem. Eng. Progr.,** Vol. 60, No. 8, p. 88 (August, 1964). A free copy of this article may be obtained by sending a post card, with the words "Key Word Article" and your name and address (please print) to Publications Department, A.I.Ch.E., 345 East 47 St., N. Y., N. Y., 10017. Price quotations for volume quantities on request.

marily boiling," and nineteen under "Miscellaneous papers, books, and reports."

With a view to the future, Professor Gouse writes "If useless repetition and lost time are to be minimized, then an effort of this kind must be continued and its results made widely available." This reviewer welcomes and recommends the services provided by Professor Gouse. The "Index" focuses on problems in coping with the literature, offers an assist, but still leaves for us to resolve our own problems of reporting and communication.

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State Space Analysis of Control Systems, K. Ogata, Prentice-Hall, Inc., Englewood Cliffs, New Jersey (1967). 596 pages, $13.95.

This book is an excellent one which should be of interest to chemical engineers who wish to understand the basic features of introductory modern control theory. The material is well written, the references are quite recent, and numerous short examples are located in each chapter. More detailed examples and problems are also presented at the end of each chapter.

To illustrate the material covered, the first six chapters (369 pages) contain a detailed description of matrix-vector manipulation, eigenvalue properties, the state space (differential and difference equation) representation of dynamical systems, and the solutions of these state equations. In Chapter 6, for example, four different procedures are detailed for evaluating the homogeneous matrix solution, exp $[At]$, and this is then used in solving the Riccati matrix equation.

Chapter 7 contains a detailed examination of the important concepts of controllability and observability and Chapter 8 is concerned with the stability of continuous and discrete systems via Liapunov's method. Among other items, Krasovskii's and the variable gradient method for generating Liapunov functions are examined. Chapter 9 introduces the concepts of dynamic programming and applies it to the optimal regulator problem.

This reviewer would have liked some material included on the maximum principle and further consideration given to the control of nonlinear systems via various computer algorithms. In any event this book will be a welcome addition to those who teach optimal control theory in graduate chemical engineering courses.

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Leon Lapidus